REMARKS

Status of Claims

Claims 1-17 are pending in the application. The claims have been amended to put the application in better condition for appeal, i.e.,

claim 1 has been amended grammatically to recite positive process steps, and

claim 8 has been amended to recite the "spherical apex" common feature of the invention.

Present Invention

The present invention provides a new generation of means to avoid defects when joining coated metal sheets by laser welding, the defects attributable to explosive vaporization of coating materials along the weld seam during laser welding.

In the case of many coated sheets, such as galvanized coated sheet metal as employed in the automobile industry, the coating material exhibits a significantly lower melting point than the melting point of the sheet material. Accordingly, during laser welding of this type of sheet, explosive-like vaporization of coating material can occur in an overlap joint, which strongly compromises the quality of the joint.

It is known to use spacers to produce a narrow gap between the sheets, so that the vaporized coating material can escape.

However, spacers produced in known manner are relatively pointy. As a result, they relatively easily penetrate or at least deform the adjacent sheet metal, or bend, whereby undesired deviations in sheet spacing occurs. In the case of thin sheet metal, the nubs can cause raised impressions on the opposite side of the sheet metal, so that the surface finish is not attractive.

The present invention solves the problem by providing:

- a coated sheet with at least one topographic change in the form of a ***spherical peak*** projecting from the surface (claims 8-10)

- a process for laser machining a coated sheet, producing a sheet with a topographic change with a generally ***spherical peak*** with a radius that is greater than the height (h) of the topographic change (claims 1-5, 11-15),
- a process for welding together two sheets, wherein at least one of the sheets has the topographic change with a generally ***spherical peak*** with a radius that is greater than the height (h) of the topographic change (claims 6, 7, 16 and 17)

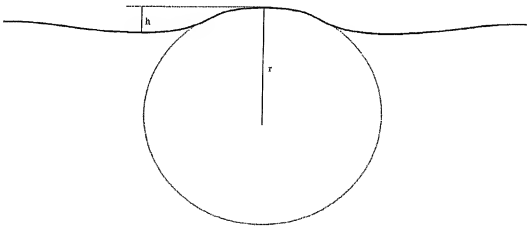

Fig. 1

As discussed in the specification, paragraph [0010], the laser beam is guided within the interaction zone of the melt so that, in addition to the mixing induced by the heating, it excites or quasi stirs the melt. This leads thereto, that the resulting topographic change becomes more "spherical" shaped at it's apex, so that it exhibits an apex radius that is greater than the height of the topographic change. This type of topographic change is more suitable as a spacer than those previously known, since, due to its spheroid shape, the following benefits result:

(a) more consistent gap [the spacer is less likely to press into the opposite sheet metal or itself become deformed, and thus less undesired deviations in sheet spacing would occur],

(b) less deformation / imprinting on opposite side of sheet [even in the case that the sheet metal is thin, no imprints are created by the topographic changes on the opposite side of the sheet metal being spaced], and

(c) better corrosion resistance [coated sheets with the topographic changes produced in the inventive manner exhibit an improved corrosion resistance compared to those produced by previously known methods since the spherical peak is less likely to penetrate into the sheet metal to be spaced apart and thus causes little or no damage to the coating, and the depression of the sheet metal, from which material of the projecting topographic changes are formed, is fundamentally flatter in shape than those produced by known methods, and thus has less of a tendency to harbor moisture (less capillary effect)].

Turning now to the Office Action, the paragraphing of the Examiner is adopted.

Claim Rejections - 35 USC § 103

Claims 1-3, 6-13, 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Coleman et al (US 6,483,069) in view of Mombo-Caristan (US 5,595,670) or Sciaky et al (US 4,626,653).

Coleman

According to the Examiner, Coleman shows the process claimed including a laser beam directed to the metal sheets wherein the laser beam produces a topographic change in the form of a generally spherical ***weld bead*** between the metal sheets wherein the ***weld bead*** has a radius greater than the height of the bead extending from the sheet at the foot of the topographic change wherein the ratio peak radius and the height is at least 2:1 (also see Figure 6C).

In response, Applicants point out that a ***weld bead*** is an elongate shape, having at best a ***cylindrical*** contour above the surface. Such a contour is both structurally and functionally significantly different from, and would not be effective for, the purposes of the present invention.

Shape and function are related as follows (claims 6 and 16): the at least one projecting topographic change brings about the formation of a gap between the at least two sheets, and the at least two sheets are then welded to each in the area of the at least one gap, in such a manner, that vaporization productions occurring welding thereby can escape through the at least one gap.

The weld bead of Coleman (which is actually the end product of welding, not a spacer to be provided prior to welding), if provided onto a coated sheet to be used for welding of two sheets, would operate as a ***barrier*** preventing escape of vaporization products, thus might actually increase the damage to the weld seam caused by trapped vaporized coating material, in contrast to the generally ***spherical peak*** of the present invention with a radius that is greater than the height (h) of the topographic change, which provides room for escape of coating material vaporized during laser welding.

The term "spherical peak" is intended herein to refer to the sphere as a three dimensional shape, not merely to refer to a round cross-section as appears in the weld seam of Coleman.

Mombo-Caristan

The secondary reference is cited to show a laser beam for welding zinc coated steel wherein the laser beam describes a circular or elliptical movement with the combination of mirrors and lenses as the transverse and longitudinal components.

In response, Applicants point out that Monbo-Caristan, like Coleman, also teaches a weld bead which is an elongate, cylindrical shape.

The secondary reference does not teach the generally ***spherical peak*** of the spacer of present invention with a radius that is greater than the height (h) of the topographic change

Sciaky

This reference is cited to show that it is known in the art to provide a combination of the mirrors to allow a laser beam to describe a movement in a circular form that includes the transverse and longitudinal movement. Sciaky also shows its laser beam that is discontinuously applied with regard to its power.

In response, Applicants point out that all references read in combination still do not teach or suggest the provision of a generally ***spherical peak*** spacer with a radius that is greater than the height (h) of the topographic change.

Vaporization

According to the Examiner, with respect to the vaporization productions in claim 6 (and 16), it is noted that such vaporization would have inherently occurred as the result of applying the laser beam as that of the recited claim 6.

In response, Applicants point out that vaporization would certainly have occurred, but it is not vaporization that the invention is concerned with, but rather the safe ***escape*** of vaporization products. Safe escape is ensured by providing a gap that is not so wide as to interfere with welding, nor so small as to prevent escape of vaporization product. The gap is sized correctly by the provision of a generally ***spherical peak*** spacer with a radius that is greater than the height (h) of the topographic change. By being spherical, the spacer will not deform, will not pierce the opposite sheet, and will provide for passage between adjacent spacers of volatilized coating material.

Accordingly, withdrawal of the rejection is respectfully requested.

Claims 4, 5, 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Coleman in view of Mombo-Caristan or Sciaky as applied to claims 1-3, 6-13, 16 and 17 above, and further in view of Stol et al (US 6,740,845) or Robertson et al (US 5,038,016).

According to the Examiner, Coleman in view of Mombo-Caristan or Sciaky shows the process claimed except for the laser beam that is not focused on the surface.

In response, Applicants point out that no combination of references leads to a generally ***spherical peak*** spacer with a radius that is greater than the height (h) of the topographic change. Thus, these claims can not be obvious over the cited references, and the secondary references do not make up the deficiencies in the primary references.

Stol or Robertson are cited to show that it is well known to provide a defocused laser beam for welding, and Stol further shows the laser beam that describes a movement in a circular or elliptical pattern, or any other desired pattern.

However, these references do not teach the provision of a generally ***spherical peak*** spacer with a radius that is greater than the height (h) of the topographic change

Response to Arguments

In response to Applicants' arguments, the Examiner points out that Coleman also shows two structure members such as shown in Figure 4A where such members are joined and welded at the gap or interface of the structure members. The applicant argues Coleman further teaches of

the smooth finished surface, but it is noted that the recited process is shown by the applied prior art. The steps that are further taken by Coleman as argued by the applicant do not negate any teachings that are shown by the applied prior art.

Applicants respond by pointing out that these references do not teach a generally ***spherical peak*** spacer with a radius that is greater than the height (h) of the topographic change.

With respect to Mombo-Caristan or Sciaky, it is noted that these references are applied to show the recited movement with transverse and longitudinal components that are known in the art which would have obvious to one of ordinary skill in the art to adapt such components in Coleman to also produce the topographic change with an increased welding process without defects.

Again, Applicants point out that these references do not teach a generally ***spherical peak*** spacer with a radius that is greater than the height (h) of the topographic change.

Finally, the Examiner concludes: "As Coleman shows the recited generally ***spherical peak*** as shown in the drawing figures and which also meets the more detailed spherical peak ratio of at least 2:1 as shown by the table in Figure 6C of Coleman, the applicant's arguments are not deemed persuasive."

Applicants again point out that, while a cross section through a sphere and a cross section through a cylinder would have the same representation, a cylinder is not a sphere. The weld of Coleman is a weld bead, which is a linear, elongate structure, of which the closest embodiment to the present invention would be a cylinder. A weld bead (a) is a final product, not a spacer provided prior to the weld bead, and (b) is not a generally ***spherical peak*** spacer with a radius that is greater than the height (h) of the topographic change, as presently claimed.

Accordingly, withdrawal of the rejection is respectfully requested.

Should further issues remain prior to allowance, the Examiner is respectfully requested to contact the undersigned at the indicated telephone number.

The Commissioner is hereby authorized to charge any fees which may be required at any time during the prosecution of this application without specific authorization, or credit any overpayment, to Deposit Account Number 16-0877.

Respectfully submitted,

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